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# The Evolving Partnership – An International Perspective

## **NASA / APPEL Masters Forum 19 Passing the Torch-2**

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Directorate of Human Spaceflight**

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- **ISS Orbit Characteristics**

- LEO ~ 400 km altitude
- 28.000 km/h – 90 minutes orbit
- Inclination 51.6°
- Covers 85% of Earth surface with 95% of population

- **ISS Space Environment**

- Cosmic rays
- Solar wind and charged particles
- Space debris
- Vacuum
- Extreme temperatures

- **ISS Platform Features**

- Manned
- Payloads retrievable
- Power/telemetry/cooling resources

**=> Microgravity & Observation/Exposure**

- Life & Physical Sciences
- Astrophysics, Astrobiology, Radiology
- Earth Observation, Navigation
- Space Technology
- Human Exploration Preparation



# Overview of Columbus Research Outfitting

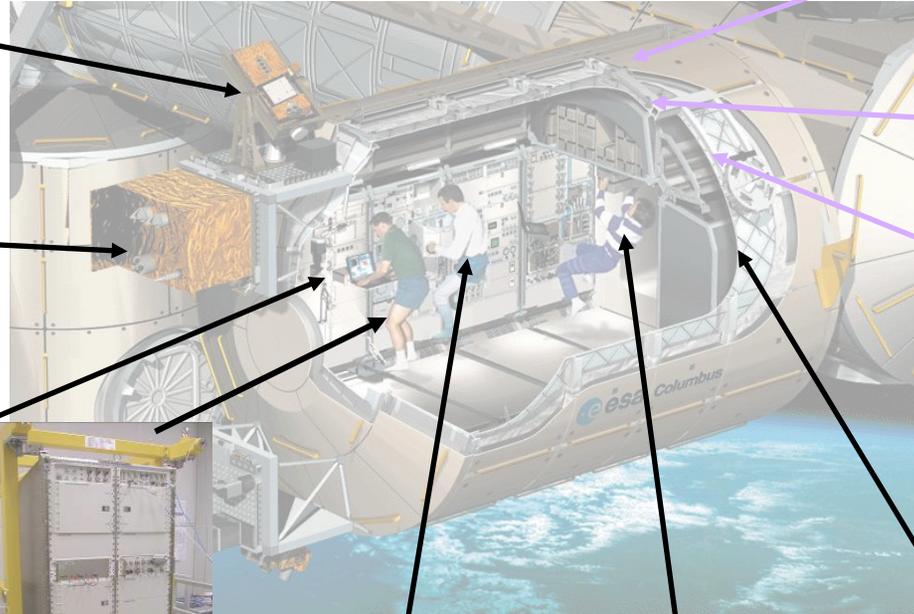
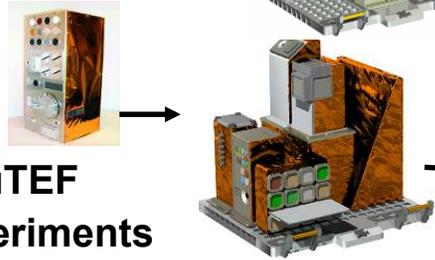
ER-3/  
EMCS



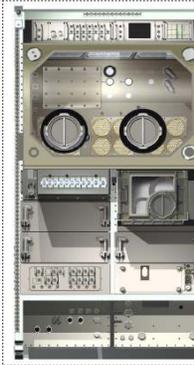
3 SOLAR  
instruments



EuTEF  
experiments

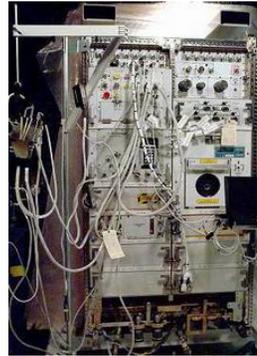


Relocation  
from US-Lab



MSG

HRF-1 /  
PFS in  
HRF-2



EDR



EPM



PCDF  
KUBIK



MEEMM + CDL



FSL



BIOLAB

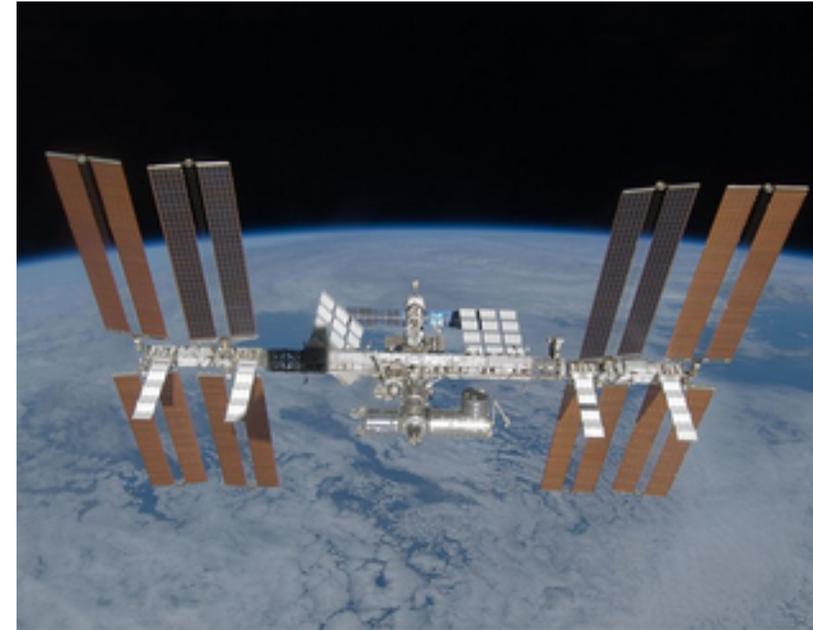


HRF-  
MARES

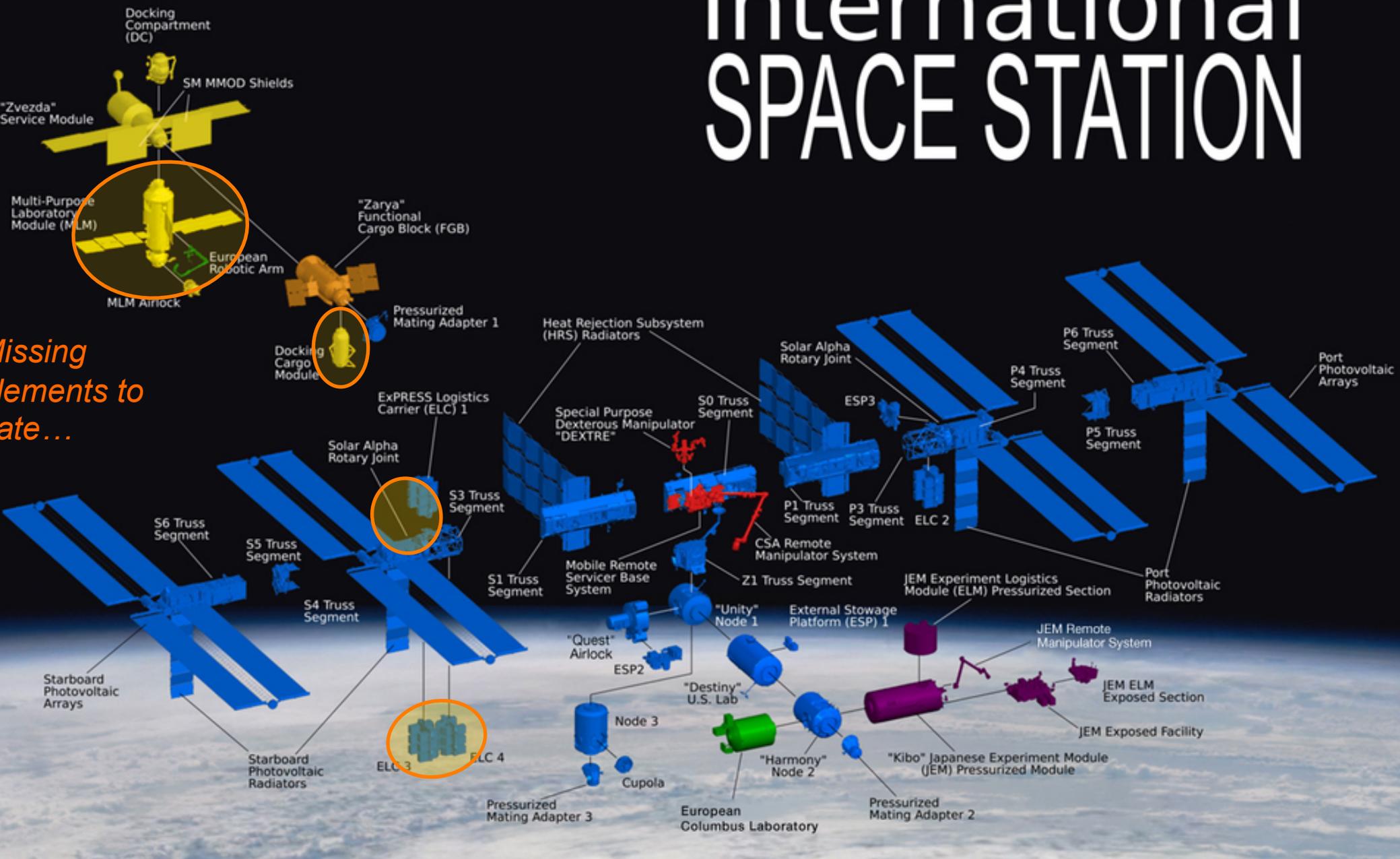


ISS is almost completed and constitutes a huge massive Orbital Laboratory complex:

- Approx ~400 tons, 750 m<sup>3</sup> (habitat); about 40% of pressurized volume built in Europe
- 102 m x 73 m x 27 m (L x W x H);
- Relying on various un- / manned space vehicle logistics;
- Numerous EVA's to assemble it;
- More than 200 visitors so far
- Orbiting at ~370 km altitude, 7.7km/s (27600 km/h, 15.7 orbits/day, orbit decay ~2 km/month);
- 16 participating nations;
- Political success, daily challenge for some 10000 people and 500 companies supporting construction and operations;
- Assembly is by now almost complete, and since end of May 2009, 6 crew members permanently occupy the orbital complex.



# International SPACE STATION

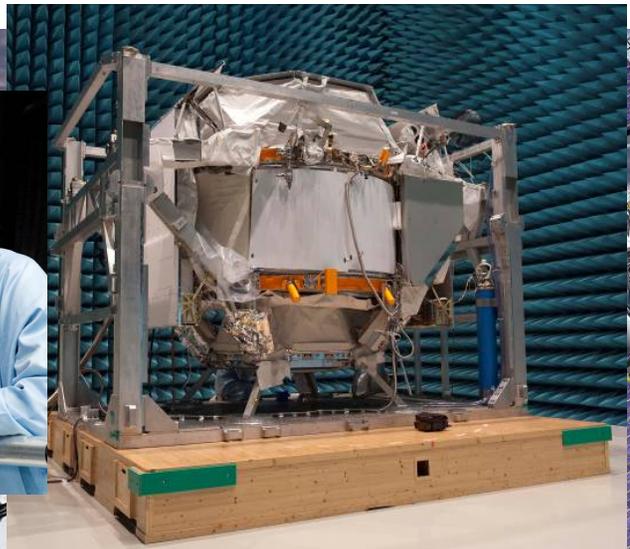
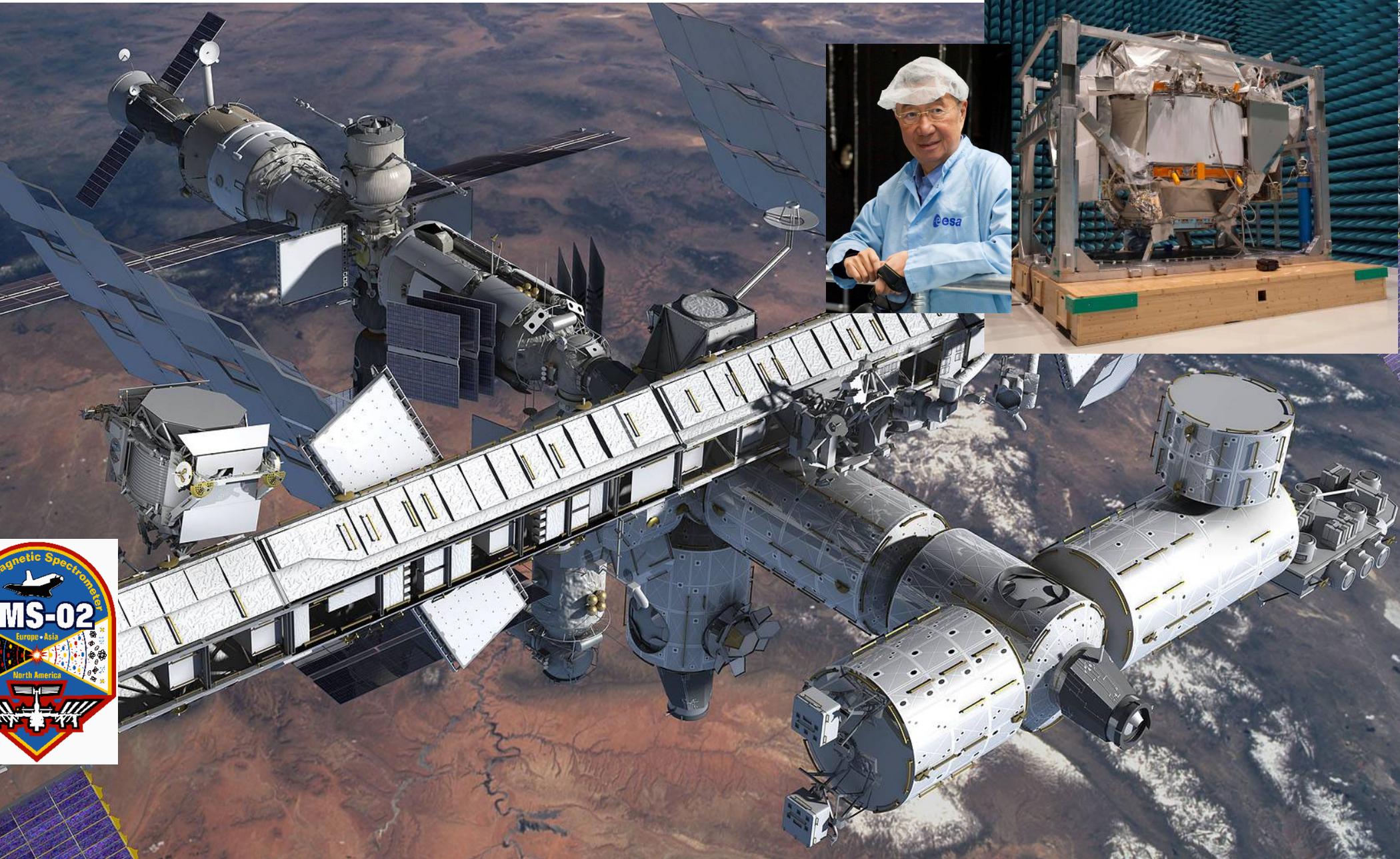


Missing elements to date...

- NASA
- NASA-provided element integrated into the Russian segment
- ROSCOSMOS
- CSA
- JAXA
- ESA

Based on Int'l Rev H Strategic Flight Plan September 1

# Alpha Magnetic Spectrometer



## ISS logistics: a joint effort between International Partners

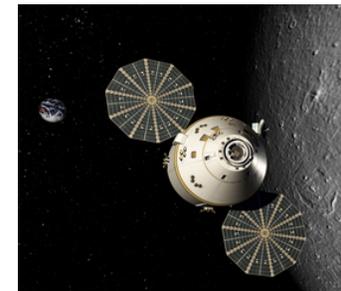
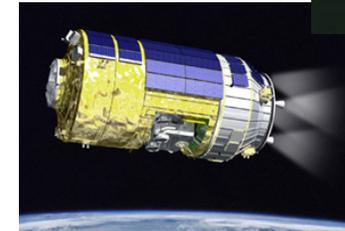
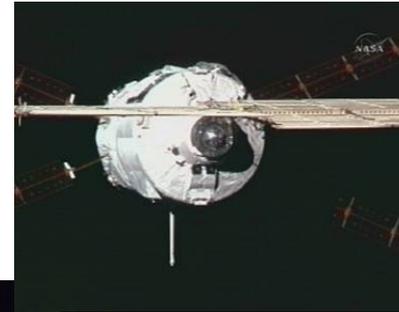
- **Assembly flights:**
  - mainly Shuttle Transportation System (STS)
  - Russian Proton rockets
- **Current Logistics / Re-supply flights:**
  - Russian-based : Progress / Soyuz
  - STS-based : Multi-Purpose Logistics M



## ISS logistics: a joint effort between International Partners

### Future Logistics / Re-supply flights:

- **ATV: Automated Transfer Vehicle (ESA-2008)**
- **HTV: Japanese Expandable Vehicle (JAXA-2009)**
- **US Commercial Cargo Vehicles (NASA-2011)**
- **Russian Soyuz evolution (2013 TBC)**
- **CEV/Orion: ISS Crew Vehicle (>2015 TBC): man**
- **ARV+: European cargo / crew capsule**



## Research Collaboration with NASA

- Traditionally wide range of joint activities
- Various agreements/barter, e.g.:
  - Early Utilisation / Cupola
  - ISLSWG, Experiment Letters
- Shared accommodation for payloads
- Joint experiments and/or combination of experiment protocols



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## International collaboration (ESA)

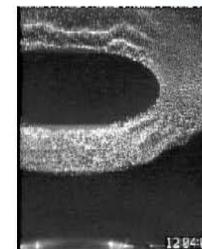
The Framework agreement between Roscosmos and ESA for collaboration in joint experiments on ISS was signed

33 joint experiments are considered. About 10 of them are prepared for primary realization :

- Plasma crystal
- Matroshka
- Immuno
- ASIM
- ATV-reentry
- PPSF
- Neurospat
- Fases
- .....



Anthropomorphic phantom for radiation doses determination in the ISS modules "Matroshka"

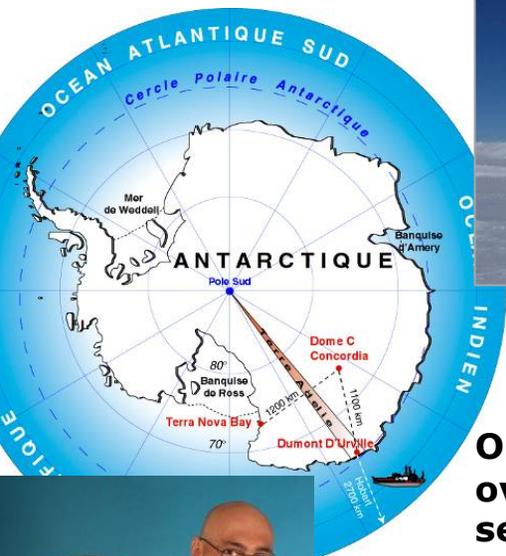


Nonlinear waves in the dust plasma "Plasma crystal"



Plasma images at the ATV-1 reentry and fragmentation in different spectrum ranges: a) UV (250-320 nm), b) visible range

### Concordia



### Bedrest + Centrifuge

Ongoing studies at DLR and MED



### Ongoing winter-over isolation session (9M)



### Ongoing training for 520-day isolation study

WE'RE BEGINNING HIS TRAINING RIGHT NOW, SO AS TO BE READY FOR THE FIRST MARS MISSION!



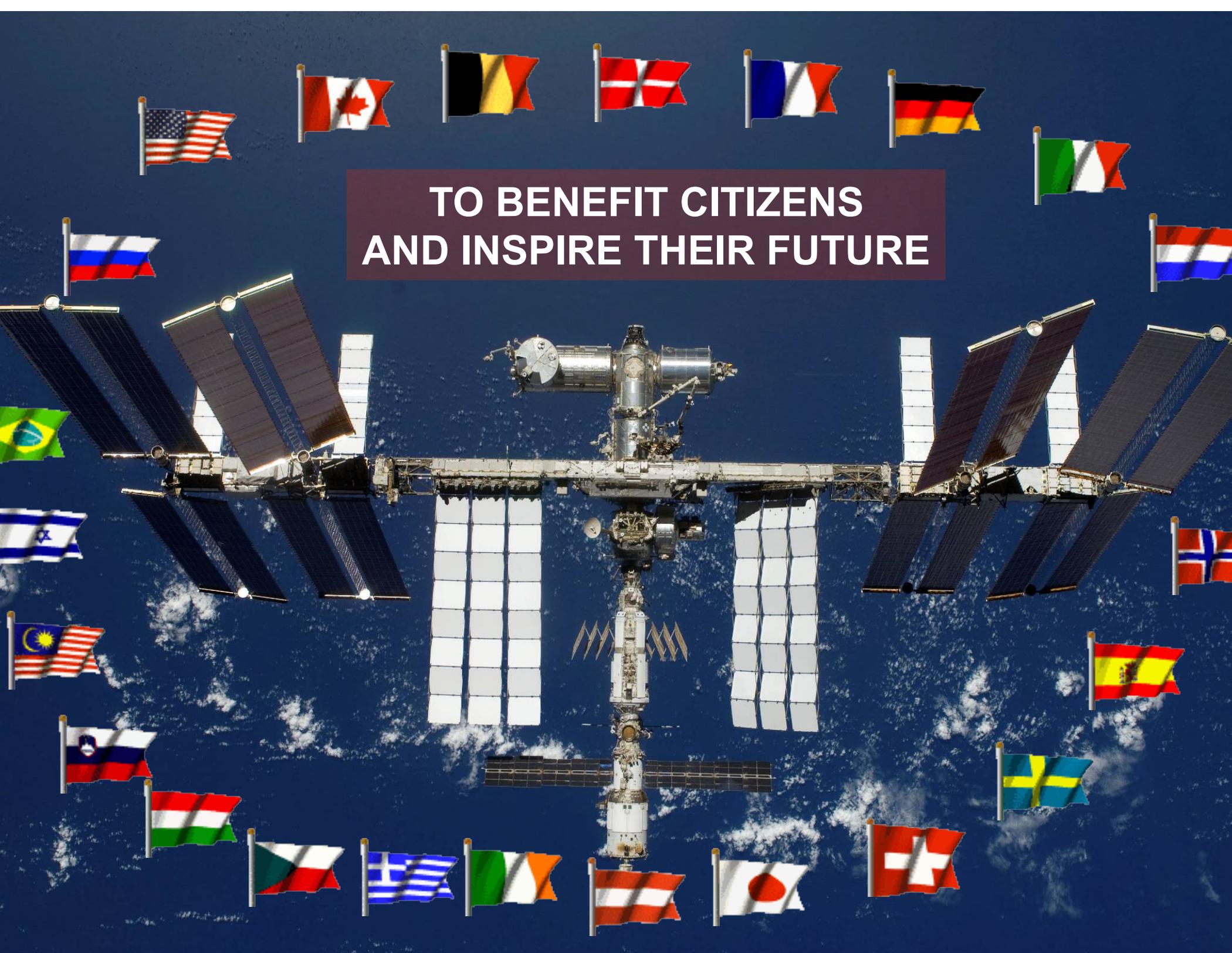
- ISS research coordination through tactical and strategic international working groups of ISS partners
- International solicitation of ISS research announcements and formation of international teams (ISS partners and beyond)
- Pooling of ISS research infrastructure assets and mission resources
- Long-term continuity of research priorities
- Expanding of ISS Utilisation portfolio
  - Climate Change Studies on ISS
  - Exploration Technology Preparation
- Evolution of on-orbit infrastructure
- Inviting non-ISS partner countries to use ISS





The unique  
**Laboratory in Space**  
and permanent  
**Observation Platform**

**>> 1<sup>st</sup> Step to Human Space Exploration <<**

The image features the International Space Station (ISS) in the center, set against the backdrop of Earth's blue sky and white clouds. The station's complex structure, including its central truss, multiple solar panel arrays, and various modules, is clearly visible. Surrounding the ISS are numerous national flags from various countries, including the United States, Canada, Belgium, Denmark, France, Germany, Italy, Russia, Brazil, Israel, Malaysia, Taiwan, Hungary, Poland, Greece, India, Austria, Japan, Switzerland, Norway, Spain, and Sweden. The flags are arranged in a circular pattern around the station, symbolizing international cooperation in space exploration. A central text box with a dark purple background and white text reads: "TO BENEFIT CITIZENS AND INSPIRE THEIR FUTURE".

**TO BENEFIT CITIZENS  
AND INSPIRE THEIR FUTURE**